DOCUMENT RESUME

ED 293 846 TM 011 265

AUTHOR Caramelli, Nicoletta
TITLE The "Schema" Concept: Bartlett Till Now. No. 21.
INSTITUTION Lund Univ. (Sweden). Cognitive Science Research.
PUB DATE 86
NOTE 20p.
PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Cognitive Processes; *Ecology; Foreign Countries; *Schemata (Cognition)
IDENTIFIERS *Bartlett (F C); Cognitive Research; *Schematic Concept Formation

ABSTRACT

In 1932, F. C. Bartlett first used the concept of "schema" borrowing it from Head, to suggest a unitary structure whose elements interacted in a complex way. This structure, which aimed to insure the continuity of the cognizing organism, was at the same time the expression of the functional principle responsible for the mutual interdependence among an organism, a human being, and the environment. Current research on cognitive processes frequently refers to the concept of "schema", but interprets it as a formal structure that can be defined by its content and reduced to its several elements. The "schema" concept, as held by Bartlett, underwent a radical change as a result of R. C. Oldfield's transposition of the original definition into the human information processing conceptual frame. U. Neisser and R. A. Schmidt interpreted the concept of "schema" so that it acquired a rule-like character as well as an anticipatory function. Only within the ecologically oriented interpretation of the cognitive processes does a true reappraisal of the meaning of "schema" as originally forwarded by Bartlett surface. The theoretical flavor of Bartlett's research exists in the ecological approach to the study of cognition. (TJH)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

THE "SCHEMA" CONCEPT:

BARTLETT TILL NOW

Nicoletta Caramelli

1987 No. 21

Communications should be sent to:

Bernhard Bierschenk

Department of Psychology
Paradisgatan 5
Lund University
S-223 50 Lund, Sweden

ABSTRACT

When in 1932 Bartlett first used the concept of "schema" borrowing it from Head, he intended to suggest a unitary structure whose elements interacted in a complex way.This structure, which aimed to insure the continuity of the cognizing organism, was at the same time the expression of the functional principle responsible for the mutual interdependence between an organism, the human being, and its environment.

Current research on cognitive processess very often refers to the very concept of "schema", but interprets it as a formal structure which can be defined by its content and reduced to its several elements.

The purpose of this paper is to show that the "schema" concept, as held by Bartlett, underwent a radical change as a result of Oldfield's transposition of the original definition into the human information processing conceptual frame.

We find in Neisser (1976) and Schmidt (1982) another interpretation of the concept of "schema". In this context it acquires a rule-like character as well as an anticipatory function. In their work the meaning expressed by the "schema" concept better agrees with Bartlett's.

However, it is only within the ecologically oriented interpretation of the cognitive processes that we can find a true reappraisal of the meaning of the "schema" as originally put forward by Bartlett. Jenkins (1980), Bransford (1977), and other psychologists who accepted the assumptions of the ecological approach, are trying to develop their own interpretation of the cognitive activity in which a major role is played by the "schema" as a functional principle according to which the organism as a whole can act completely attuned to its environment.

It is precisely in the ecological approach to the study of cognition, in which the word "schema" is rarely used but its original meaning is always present, that we find alive the theoretical flavour of Bartlett's research.

THE "SCHEMA" CONCEPT: BARTLETT TILL NOW

Only recently have psychologists begun to appreciate what many years ago Bartlett tried to convey in his book Remembering.

But the true acknowledgement of Bartlett's contribution to the study of cognition is not to be related to the success of cognitive psychology or of the cognitive science paradigm. The psychologists who follow these approaches always refer to Bartlett's name, work, and his "schema" concept. They fill their works with the word "schema", they find this concept useful to explain "pattern recognition", "story grammar", remembering and human motor behaviour. In most of the books they write, there is always some mention of "schema" or "schemata" and Bartlett is always acknowledged as the father of this conception.

Bartlett, on the contrary, would not be happy about this success and late revival of his work. He would say that contemporary cognitive psychologists are surely speaking of "schema" and "schemata", but meaning something completely different from what he intended to mean in his book about remembering.

If this is true, as I believe, we face two problems: The first one is to explain how it is possible that so many people make so patent a mistake as to ascribe to Bartlett ideas he never had. The second one is to inquire if in the contemporary psychological literature it is possible to find at work, perhaps under labels different from the "schema" one, the ideas Bartlett really held. In order to answer these questions, in the following I will point out the role played by the Human Information Processing approach in transforming Bartlett's concept of "schema". Then I will argue that the efforts made by Schmidt (1982) as well as by Neisser (1976) to redefine the "schema" in a rule-like fashion were not successful in recovering Bartlett's interpretation. Instead, I suggest that to day the reappraisal of the concept of "schema" in its original meaning is to be found in the theoretical realm of the so called ecological approach to cognition.

The origin of the misunderstanding.

The responsibility for the misunderstanding of the concept of "schema", so that it now means something conceptually very different from what Bartlett intended, is to be ascribed to the same cognitive psychology approach at its very beginnings. Even though now it can appear ironic, it was exactly the human information processing approach to cognitive processes as well as the man-computer analogy that betrayed the original meaning of the concept of "schema".
Actually, Oldfield, in 1954, attempted to translate Bartlett's concept of "schema" into the language used for storing information in the computer. He was dissatisfied with the already worn out conception of recall as the reproduction of the "lifeless" traces left in the mind by past experiences. Moreover he knew that the method of storing information in terms of permanent traces was equally out of favor with designers of modern computing machines.
In his opinion, the memory circuit of a computing machine could afford a better analogy for remembering than trace storage since such a device had a greater functional flexibility than the semi-permanent traces, and could offer a better model of the human memory than the older one which was based upon the photograph or grammophone record analogy.
Using this justification Oldfield extended the new principle of storage based upon circuital storage elements to recall, defined as a reconstruction based upon fragments of experience by the operation of the schemata which themselves incorporate general laws and principles expressing the uniformities of experience.
Due to the criticism made by Koffka and Bartlett of the trace theory of memory, Oldfield accepted, by and large, the findings by Bartlett and tried to develop a theoretical reformulation for those findings whose characteristics the computer model of storage was thought to preserve.This kind of storage, in his opinion, was comparable to Bartlett's use of the "schema" provided that the storage box had enough 'experience' of incoming information so as to acquire a store of type sub-sequences able to represent common elements in the events in its environment. As Oldfield said:

> Treated as a total organized system, which they (the type sub-sequences) form in virtue of the

> various connections between them which could be generated by re-codings of higher order, they may be said to form its "schemata". For it is upon the basis of them that reconstruction of particular past messages is possible...in this sense it might be said that the box's schemata form an active organization of past experience. (Oldfield, 1954, p. 20 .)

The new concept of "schema", arising from the coupling of Bartlett's experimental findings on recognition and recall with the mechanical processes of storing information in the computing machine, had no resemblance to that put forward twenty years before by Bartlett. Oldfield's redefinition of "schema" has made it a way of, or a procedure for, storing input, regardless of whether they are physical stimuli to be put into a living organism, or symbolic information to be stored into a computer or something else. The functioning of the "schema", in this new theoretical context, is based on a well-defined operation - higher order recodings - and on an economical principle, since the "schema" is an abstractive device capable of re-organizing its own information. The same functioning of the "schema", however, is embodied in a structure: the storage of the type sub-sequences.

Thanks to Oldfield's re-interpretation of the concept of "schema" the name of Bartlett was rescued, but his original theory was forgotten, at least until recently. The successful attempt by Oldfield to translate the concept of "schema" from the theoretical world of Bartlett into that of information processing was only one among many other efforts to quantify and operationalize the principles and concepts of psychological research.

In those years the mathematical theory of information processing strongly reinforced the ideals of rigour, precision, objectivity, and quantification held before by behaviouristic psychology and now extended to the study of the cognitive processes. The acceptance of the human information processing approach obviously reduced the cognitive activity to structure, to several sub-processes easily handled by quantifying procedures.The formalized "schema" concept had many properties relevant to the study and to the interpretation of the new problems and themes which the cognitive approach was beginning to focus on. As Attneave clearly stated:

> The ideas of information theory are at present stimulating many different areas of psychological inquiry. In providing techniques for quantifying situations which have hitherto been difficult or impossible to quantify, they suggest new and more precise ways of conceptualizing these situations. (Attneave, 1954, p.183).

So, he himself (1955) tried to re-interpret the Gestalt psychology concept of "good figure" in terms of information redundancy, precisely in the same period in which Oldfield was re-interpreting the concept of "schema".
It is clear that both the man-machine analogy and the human information processing hypothesis were useful to revitalize psychological research as well as theory. However they also brought into psychology implicit assumptions whose theoretical pitfalls are now beginning to spring up. At least two of these assumptions are worth mentioning to show how far the new interpretation of the "schema" concept was , and still is, from Bartlett's.
First, for Bartlett the name "schema" referred to a functional principle, and not only to a structural element of our mind. In the man-machine analogy, the "schema" is a particular kind of empty organization, it is a store defined by the operations necessary to store in it the incoming information. It is exactly according to this organizational view that in contemporary research psychologists equate the concept of schema to that of "frame" (Minsky, 1975) or "script" (Schank, 1973) in artificial intelligence. More generally, in story telling grammar the "schemas" are defined as:

> Generic knowledge structures that guide the comprehender's interpretations, inferences, expectations and attention.A schema is <u>generic</u> ... consists of <u>knowledge</u> ... <u>is highly structured</u> ... has <u>variables</u> which are eventually <u>filled</u> as a schema guides the comprehension of specific input ... it is <u>instantiated</u> when variables have been filled and conceptually interrelated in a specific context...[there are] two stages of schema utilization, called <u>schema identification</u> and <u>schema application</u>. (Graesser,Nakamura,1982,p.60-62).

Bartlett would never agree with this kind of definition. In his work, perhaps misconceiving Head's concept of "schema" as Bierschenk has noticed, he disagreed with the thesis held by the neurologist according to which the cortex is simply a "past impression store". Bartlett argued that a store is a place in which you put things hoping to find them again, if necessary, exactly in the same conditions in which you put them there, while "schemata" must be thought of as alive, always developing, influenced anew by the sensory experiences which are going on. In Bartlett's view the "schema" is neither a store, nor a structure; as he said: "I think probably the term "organized setting" approximates most closely to the notion required"(Bartlett,1932,p.201).

The second assumption from the man-machine analogy I will now examine is the representation argument. Assuming that human beings are to be considered as processors of information, we can say that to build a model of the cognitive processes, we have to postulate a symbolic structure, representation, reproducing in the mind the external world and the knowledge we have of it, on which the processes can operate to produce our cognitive behaviour.

In contemporary psychology, the problem of representation is surely a hot and controversial one; nonetheless it is commonly held that in order to understand how people process information, we have to know what it is that people process. On this ground, i.e. the human information processing approach, it is taken for granted that the paradigmatic psychological process is a sequence of transformations of mental representations. Since the "schema" is conceived of as a "knowledge structure", the equivalence between the representation and the "schema" becomes obvious.

The concept of "schema" as a representational device, however, holds only if we accept that the human mind transforms information in the same way computers do, that, in fact, the mind is precisely a computing machine.Bartlett never accepted the idea that the cognitive processes could be understood through the analogy of the computer. In his theory there is no room for this analogy. For Bartlett, remembering, as well as the other cognitive activities,is the result of the entire functioning of the living organism according to a biologically oriented perspective. Thus,in order to acquire knowledge, living organisms have no need for an internal stage, i.e. the representation, in which the external world is to be replicated to assume the label "knowledge". Knowledge itself is the product of the complex

functioning of that peculiar living system which is called the human being. Mind is the product of the interaction between the living human organism and its environment, and the problem of representation, if it is a problem, has to be discussed at a different level of complexity.
Bartlett highlighted this notion of "schema" when he argued that "schemata" find their origin in and are fed by the instincts, feelings, attitudes and interests of the organism in the continous process of experiencing. As Bartlett observed:

> What precisely does the schema do? Together with the preceeding incoming impulse it renders a specific reaction possible. It is, therefore, producing an orientation of the organism toward whatever it is directed to at the moment. But that orientation must be dominated by the immediately preceding reactions or experience. To break away from that the schema must become not merely something that works in the organism, but something with which the organism can work. The organism discovers how to turn around on its own schemata. In other words, it becomes conscious. (Bartlett, 1932,p.207).

From these words it is clear that the "schema" is the expression of the organism as a whole, a very complex whole, whose activity, be it physical or mental, cannot be properly understood if it is reduced to or decomposed into different and independent parts. Perceiving, imagining, remembering, and thinking are the different outcomes of the organism actively engaged in interacting with its natural and social environment.

The concept of "schema" as a rule.

Another way to conceive of the functioning of the "schema" is in a rule-like fashion. This view also results from the human information processing approach, but its scope is more limited since it aims only at stressing the functional character of the "schema". There are two contemporary authors that use the concept of "schema" in this way: R.A.Schmidt and U.Neisser.

Schmidt tries to understand human motor behaviour assuming a rule-like definition of the "schema". According to his theory, motor skills are produced by a program in which are stored the relationships existing among the several parameters necessary to give the proper shape to the movement. Such abstract relationships which form the "schema" enable the establishment of a 'rule' to handle similar situations in the future. The functioning of the "schema" in this case consists in a continous updating of the rule in such a way that the data on which the rule is updated are thrown away, while the updating rule is kept.
In Schmidt's theory, human motor skills are seen precisely as generalized motor programs in the computer science perspective; however "schemata" functions in the exact same way as they do in Bartlett's theory of recall. In both these views, "schemata" are not structures but merely princples and rules defining the process according to which a function is accomplished. Nonetheless in Schmidt's theory of motor skills, it is not stated what the motor program aims at, or why, or when: in brief, there is no living organism to make the program start or stop.
As to Neisser, in his Cognition and Reality, he has tried to transfer to perception what Bartlett had said about skills. In his view, perception is a skill, since perceiving in a way is also a kind of doing, and the "schema" is considered its central cognitive structure. As he put it:

> The schema accepts information as it becomes available at sensory surfaces and is changed by that information; it directs movements and exploratory activities that make more information available by which it is further modified. The schema is not only the plan but also the executor of the plan. It is a pattern of action as well as a pattern for action. (Neisser,1976,p.54-56).

In this case the rule can be not only updated but also acquires an anticipatory character.
Another point of Bartlett's theory which is shared by Neisser is the idea that it is not necessary to assume the existence of representations in the mind, at least of the kind usually assumed in the human information processing perspective. For Neisser:

> It may be wise to avoid the connotation that there is a final constructed product in the perceiver's mind; that we see internal representations rather than real objects. This, I think, is not true. By constructing an anticipatory schema, the perceiver engages in an act that involves information from the environment as well as his own cognitive mechanisms. He is changed by the information he picks up. The change is not a matter of making an inner replica where none existed before, but of altering the perceptual schema so that the next act will run a different course. Because of these changes, and because the world offers an infinitely rich texture of information to the skilled perceiver, no two perceptual acts can be identical. (Neisser, 1976,p.57).

Neisser, just as Bartlett many years before, wants to sketch out a view of the cognitive processes and, in general, of the human nature that is more complex than the implicit assumptions of the human information processing approach. Though we must agree with this effort by Neisser on a philosophical ground, this proposal is too vague to help re-model the study of cognitive processes; the concept of "schema" he so widely appeals to looks more like a "deus ex machina" than a theoretical concept on which to build an articulated theory of cognition.

The ecological approach.

The theoretical effort Neisser made ten years ago,suggesting the hypothesis of the 'perceptual cycle' in which the "schema" played the afore mentioned role, has become part of the so called ecological view of the cognitive processes. It is precisely within this perspective that, in my opinion, the concept of "schema", as originally put forward by Bartlett, and his global view of the cognitive activity find true and reliable followers.
In a recent paper entitled Toward an ecologically oriented Cognitive Science, Neisser acknowledges to the European ethologists the merit of having shaped the ecological paradigm, an alternative to the human information processing one.As he puts it:

THE "SCHEMA" CONCEPT:

BARTLETT TILL NOW

Nicoletta Caramelli

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☐ This document has been reproduced as received from the person or organization originating it.

X Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

BIERSCHENK

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

> The ethologists were less interested in theories than in the animals themselves...To understand ...animals it was necessary to conduct field studies, observing them in their natural habitats. The details of each environment were important. Each species is attuned to those details in its own way, fitting neatly into what we now call its 'ecological niche'. It is impossible to understand any piece of animal behaviour without considering its context and its adaptive significance ..[since]..the very same animal may learn differently in different settings or at different stages of maturation. Many types of learning that occur in the field do not appear in the laboratory at all unless the laboratory has been designed with the field in mind. (Neisser,1985,p.21).

The new view of animal behaviour has helped remodel the general principles of learning and has strongly influenced the study of human behaviour too. Its importance in weakening the most salient flaws of the human information processing approach is widely acknowledged. The account of human nature given by the human information processing view is limited since cognition is taken out of context. In this approach, experiments test hypotheses about the mind rather than about the environment and are typically conducted in convenient rather than ecological settings. As Neisser says:

> Instead of engaging in natural activities, subjects are confronted with arbitrary and stripped down tasks designed to test particular theoretical models .... subjects are asked to memorize irrelevant materials, solve artificially constructed puzzles or perform stereotyped tasks repeatedly and rapidly so that their response times may be measured. Such tasks do not seem to catch people at their best; they offer few opportunities for the exercise of ordinary cognitive skills. (Neisser, 1985,p.19).

I don't think it is worthwile to dwell on the tenets of the ecological approach any longer. I only want to make clear that the revival of Bartlett's approach to the study of

cognitive processes rests on some ideas held also by the ecologically oriented psychologists.

It is fair to keep in mind that, prefacing his book on remembering, Bartlett pointed out that, being experimental psychology one of the biological sciences, he adopted a functionalist perspective in studying the 'conditions' and the varieties of 'conditions' in which perceiving, imagining and remembering take place. This is precisely what the ethologists studying animals do. Bartlett's ecological attitude is also evident in his repeated effort to stress that he was not interested in studying subjects' reactions, but human beings in their every day natural condition. This is the reason why he studied remembering in natural settings or in unconstrained laboratory situations, using very simple tasks such as copying drawings or recalling stories, and, as everybody knows, he was the first to study remembering over extended periods of time.

Another aspect of Bartlett's approach, shared by the ecological perspective, must be mentioned. It is put forward by Jenkins in Can we have a fruitful cognitive psychology. He observes that Thorndike,Bartlett, and Katona "were concerned with organization, structure and relations in the material, with the structure of the experiment and with structures available in the subject's experience"(Jenkins, 1980,p.222).In his view these three aspects of psychological research must be considered together to properly understand cognitive functioning. To have an adequate theory,it is not enough to put together the results of experiments on simple elements since, as Jenkins says:

> What is apparently the simplest way to study a phenomenon may not in fact capture the relationships, the structures and the complexity which are necessary to the understanding of events at higher levels. There are obviously emergent properties: to study complex relations one must be dealing with enough elements to form relations. No study of simple tones will inform one as to melody, no study of simultaneous effects is informative about sequences and so on. (Jenkins,1980,p.225).

The emergent properties which Jenkins is referring to are exactly the "schemata" Bartlett used to explain perceiving, imagining, and remembering. Actually, Jenkins notes:

> Just having one's eyes open and facing the screen does not guarantee that the information on the screen will be transferred to the viewer; one apparently needs higher order structures to perceive and assimilate the information. (Jenkins,1980,p.232).

These higher order structures have the same function that schemata have in Bartlett's view. "Schema" is the name he used to refer to the active organization of the past reactions and experiences we have to assume are active in every adequate response by the organism. A certain response is possible only if it is related to the previous, similar responses which act as a unitary mass. This unitary mass, the "schema", is produced by the complex relations holding among the total responses already produced by the organism so that we can say that it is a higher order unit in the cognitive functioning.

To properly clarify the way in which the "schema" acts, I would suggest that the analogy Runeson proposed between a 'smart instrument', as the polar planimeter, and perception be extended to the "schema" concept.

Actually, the planimeter does exactly what Bartlett meant when, following the analogy by Head, he argued that the "schema" is a complex standard which functions in exactly the same way as a taxi meter which directly expresses the distance travelled in the amount of money to be paid. The only difference is that the planimeter, following the border line of an irregualar shape, calculates its area, the taxi meter calculates how much the travel costs. So the taxi meter and the planimeter are mechanical devices which share the property of directly transform data of a certain kind into another form, according to a principle, or a set of rules, which are implicit in their functioning.

The "schema", just like the taxi meter or the planimeter,is conceived of as a mechanical device capable of accomplishing its complex task in a direct way: all these devices are specialized in a specific type of task to be performed in a particular type of situation. This is the reason why, to do their job, they can capitalize on the peculiarities of the situation and the task.

It is exactly this direct link between the situation and the task, which in the living organism exists between the environment and the cognitive functioning of the "schema",

which is the core of this analogy. In both cases this link is the expression of the complex attunement, mechanical,yet not simply repetitive, in the planimeter or the taxi meter, biological in the functioning of the organism through the "schemata", between the environment and a device or a "schema". This attunement is produced by the functioning of the "schemata" in order to realize the adaptive behaviour of the organism as a whole. In the organism as a whole we cannot establish sharp distinctions between the biological and mental dimensions, or between the so called cognitive activities. As Bartlett noted fifty years ago, there is a biological and functional continuity among perceiving, imagining, remembering, and thinking, since all these functions rest on the continous activity of the "schemata" which set the unifying principle of the cognitive processes in the living organism.

In my opinion, an approach to cognitive processes very similar to Bartlett's is held to day on sophisticated theoretical grounds by some ecologically oriented scholars as Bransford and colleagues. In Toward unexplaining memory they explicitly aim at redefining remembering following Bartlett's commitments.

A detailed comparison between Bransford's and Bartlett's views about remembering is not required here. I only want to stress their common refusal to study memory as the static repository of past experience and their common interest in remembering as the activity through which past experience organizes the cognitive functioning. In Bransford's view, remembering is the process by which previous experiences allow the enactment of novel but appropriate behaviour - may they be physical, as in skilled actions, or cognitive, as in perception or learning. This is the ecologically correct way to speak of the influence of past experience on the functioning of the organism as a whole.

Following Barlett, Bransford suggests that remembering involves processes similar to thinking since:"Both processes frequently begin with an abstract 'attitude' or ' level of attunement'that needs to be further articulated or focused"(Bransford et al., 1977,p.462). This further focusing is accomplished by the massive influence of past experience, that is by the "schema": as he says, "A major role of past experience is to provide 'boundary constraints' that set the stage for articulating the uniqueness as well as the sameness of information"(Bransford et al., 1977,p.434).

If we translate this view into Bartlett's perspective, the stage setting - a smart mechanism, as well - corresponds to the activity of the "schema" instantiated by the boundary constraints, which correspond to the attitudes, feelings, and interests of the organism, in order to realize the attunement between the organism and its environment.
For these reasons I think that in the recent ecological approach to the study of cognition Bartlett's view as well as his concept of "schema" have found their proper theoretical grounds. In the ecological framework the analogy between the "schema" concept and a 'smart instrument' acquires its heuristic value in enlightning the role held by the schema as a higher order unit in Bartlett's interpretation of the cognitive processes.

Some concluding remarks

A few words to summarize my argument: Throughout this essay I have tried to show the incompatibility between the recent uses of the concept of "schema" re-defined so as to fit the human information processing approach and its original formulation as used by Bartlett to explain his experimental findings on remembering.
I then questioned the adequacy of the rule-like interpretation of the "schema" concept by Schmidt and Neisser. Both their interpretative efforts, though in a different way, were wanting a more articulated theoretical framework.
My third and final step was to suggest a new view for the concept of "schema" which I think more loyal to its original meaning.
In the light of the ecological approach to cognition and in accordance with the analogy to the 'smart mechanisms', the "schema" can be conceived of as a higher order behavioural unit whose functioning aims at establishing the attunement between the organism and its environment according to the boundary constraints set up by the organism's attitudes, interests, and needs.
The "schema" has to be thought of as the expression of a very complex and rather irreducible function of mental activity: its task is the maintenance of the continous link between the organism and its environment established by its

very life. From this perspective, it is meaningless to reduce or to deny the complexity of this relationship.
This, I think, is what Bartlett taught us with his "schema" theory. Now we can see the "schema" concept recovered in its specific meaning by those ecologically oriented cognitive psychologists who want to interpret human behaviour in all its complexity, keeping in touch with the views put forward by the pioneers of experimental psychology, as Bartlett surely was.
We are sorry for Zangwill who in 1972 observed: "These rescue operations are understandable, but the theory, [Bartlett's], in my view never very plausible, is perhaps best forgotten"(Zangwill,1972,p.127). After fifteen years, we can definitely say that he was wrong.

REFERENCES

ATTNEAVE, F. Some informational aspects of visual perception. Psychological Review, 1954, 61, 183-193.

ATTNEAVE, F. Symmetry, information, and memory for patterns. The American Journal of Psycology. 1955, 68, 209-222.

BARTLETT, F. C. Remembering - A study in experimental and social psychology, London: Cambridge University Press, 1932.

BIERSCHENK, B. Conceptions of cognitive functions in a science of knowing. Didakometry (Malmö, Sweden: Department of Educational & Psychological Research), No.63, 1981.

BRANSFORD, J. D., MCCARRELL, N. S., FRANKS, J. J., NITSCH, K. E. Toward unexplaining memory. In R. Shaw, J. Bransford (eds.), Perceiving, Acting and Knowing, Toward an ecological psychology, Hillsdale,N.J.: Erlbaum Associates, 1977.

GRAESSER, A. C., NAKAMURA, G. V. The impact of a schema on comprehension and memory. In G. H. Bower (ed.), The Psychology of Learning and Motivation, vol. 16, Orlando: Academic Press, 1982.

JENKINS, J. J. Can we have a fruitful cognitive psychology ? In J. H. Flower (ed.), Cognitive Processes - Nebraska Symposium on Motivation. Lincoln: University of Nebraska Press, 1980.

MINSKY, M. A frame for representing knowledge. In P. H. Winston (ed.), The Psychology of Computer Vision.New York: McGraw-Hill,1975.

NEISSER, U. Cognition and Reality. San Francisco: Freeman, 1976.

NEISSER, U. Toward an ecologically oriented cognitive science. In T. M. Shlechter, M. P. Toglia (eds.), New Directions in Cognitive Science. Norwood: Ablex, 1985.

OLDFIELD, R. C. Memory mechanisms and the theory of schemata. British Journal of Psychology, 1954,45, 14-23.

RUNESON, S. On the possibility of 'smart' perceptual mechanisms. Scandinavian Journal of Psychology, 1977,18, 172-179.

SCHANK, R. C. Identification of conceptualizations underlying natural language. In R. C. Schank, K. M. Colby (eds.), Computer Models of Thought and Language. San Francisco: Freeman, 1973.

SCHMIDT, R. A. The schema concept. In J. A. Scott Kelso (ed.), Human Motor Behavior: an introduction. Hillsdale: Erlbaum Associates, 1982.

ZANGWILL, O. L. Remembering Revisited. Quarterly Journal of Experimental Psychology, 1972, 24, 123-138.

****

Nicoletta Caramelli is associate professor at the Department of Psychology of the University of Bologna, Viale Berti Pichat, 5 - 40126 Bologna, Italy.

This paper was presented at the symposium 'From Gegenstände Höherer Ordnung to Higher-Order Invariants' at the: Fourth International Conference on Event Perception and Action, August 24-28,1987. Trieste, Italy.